Washington Park
ARBORETUM BULLETIN

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Concerning This Issue...

Thank you Palma Hoppel for a job well done! I was able to enjoy my maternity leave knowing that the *Bulletin* was in good hands. The pollen issue was a major effort that is beautiful as well as informative. I would also like to thank again Bastiaan Meeuse whose prolific contributions to the *Bulletin* are invaluable. Speaking of whom, on page two we have Part II of Flower-birds and Bird-flowers in which "Bas" discusses hummingbirds.

This issue of the *Bulletin* we has a wide variety of topics and places, from Nepal to the Bikini Islands to Southwestern Washington. Tamara Buchanan of Sweet Briar Nursery and Doug Benoliel of Native Landscaping & Design share their plant hunting trek to Nepal where they found beautiful shrubs and perennials that may be hardy in warmer pockets of the Pacific Northwest. Dr. Gessel and Dr. Walker continue with Part II of their article on the effects of nuclear testing on the vegetation of the Bikini Islands. And Estella Leopold discusses the effects of time and man on the vegetation of Southwestern Washington in her article, "An Ecological History of Old Praire Areas." Those of you who are madly buying and planting bulbs in your garden for next spring should read the report from the Natural Resources Defense Council on endangered bulb species.

Nancy Pascoe
Editor

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The Washington Park

Arboretum Bulletin

VOLUME 50, NUMBER 3, FALL 1987

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Lily, by Clare Leighton (b.1901)
INSIDE FRONT COVER
Slug, by Clare Leighton
Both are original lithographs
from the book *Four Hedges*,
(New York: McMillan Co., 1935)
curtesy of Carolyn Staley Fine Prints
313 First Avenue South
Seattle, Washington 98104

Flower-birds and Bird-flowers

Part II

BASTIAAN J.D. MEEUSE

Advice for gardeners who like hummingbirds

A practical question for gardeners who also love birds is: what plants to grow to attract hummers? What we have said about resource sharing in Part I of this article (*Arboretum Bulletin*, Vol. 50, no. 2, Summer, 1987) must be very reassuring to these persons. All sorts of flowers that make nectar, rathar than just pollen, available to their visitors will do. Naturally, some are better than others. They do not have to be red, and fragrance, which the birds do not percieve anyway, is no deterrent. The size of the flowers and the width of their corolla tubes are not crucial either. It never ceases to amaze me that our native rufous hummingbird (*Selasphorus rufus*) may, on occasion, even go for the very small and extremely narrow flowers of red valerian (*Centranthus ruber*). According to the literature, this bird species has been observed at no fewer than 21 plant species; the rubythroat, *Archilochus colubris*, its counterpart east of the Mississippi, on twenty-eight. Personally, I consider these figures serious underestimates. For American gardeners I recommend especially (in addition to the plant species already mentioned) fireweed and foxglove, which, as semi-wild plants, can easily be grown in mass, red columbine (*Aquilegia formosa*), delphiniums, nasturtiums, *Buddleia*, hollyhock, penstemons, petunias, cannas, *Lantana, Verbena,* irises, morning glories, beebalm (*Monarda didyma*), tobacco, lilac, salal, yucca, huckleberries and blueberries — the list seems endless! Having a rich-flowering madrona tree on your property will not hurt either.

Hummingbird acrobatics

Watching hummingbirds in action on your flowers is pure delight. There does not seem to be anything pedestrian or earthbound about them. Their Latin name, *Trochilidae*, is derived from an ancient Greek word which simply means "bird." And indeed, they are birds *par excellence*, "the" birds; most if not all of their activities (feeding, bathing, even nest building) are carried out "on the wing." Audubon called them glittering fragments of the rainbow. Their lovely metallic colors may change as their bodies turn — which is not surprising when one considers that these colors are not simply due to the presence of a particular pigment, but are structural so that they

Female rufous Hummingbird (Selasphorus rufus) *incubating eggs.* *photo: Tom Boyden*

change with the angle of incidence of the light, just as soap bubbles. As aerial acrobats, hummingbirds are unsurpassed. They can fly forwards and backwards but can also somersault or hover in front of a flower without seeming to move at all. Scheithauer describes how a particular hummingbird, intent on burglarizing a hanging flower *from above* by piercing the calyx, rotated its body around a vertical axis while its head was down and its beak in contact with the calyx. It literally transformed itself into a drill!

Photographing a flying hummingbird requires very special techniques because their wingbeat is incredibly fast: for hovering flight, it is about 30 strokes per second for most species (up to 80 for males of *Calliphlox amethystina*). For comparison, we mention that a swan manages one and a half beats per second, a sparrow 13, a honeybee 190, and a mosquito about 500. In courtship flights and straight forward flights, a hummer's wingbeat frequency goes up. Maximum forward speed, measured by letting hummingbirds fly against known airspeeds in a wind tunnel, is about 30 miles per hour. During migration, very high speeds can be maintained for hours on end, and it is not surprising that hummers have the strongest flight muscles of all birds relative to their body-weight. Their wings also move forward and backward, rather than up and down as in other birds. To achieve this, they have a very special strong joint in each wing.

The metabolism of hummingbirds

Few people who watch these "flying jewels" flit from flower to flower are aware of the fact that a typical hummingbird is constantly on the verge of death. The smaller an animal is, the faster its rate of metabolism (the faster it burns up the substances in its body with the aid of oxygen). Some hummingbirds are not much larger than a bumblebee and weigh not more than a dime, and these have the highest metabolic rate of any bird or mammal. Even when they are resting, it exceeds that of an elephant a hundredfold! In the day time, the little beast can stave off disaster by visiting hundreds of flowers, probably up to 2000, for calorie-rich nectar. Should a sprinter wish to equal this

A Hummingbird's view of two Fuchsia *flowers.*
photo: author's

daily hummingbird performance, relative to his body weight, he would have to produce (and first consume, of course) the equivalent of 155,000 calories, rather than the 3000 a human athlete requires!

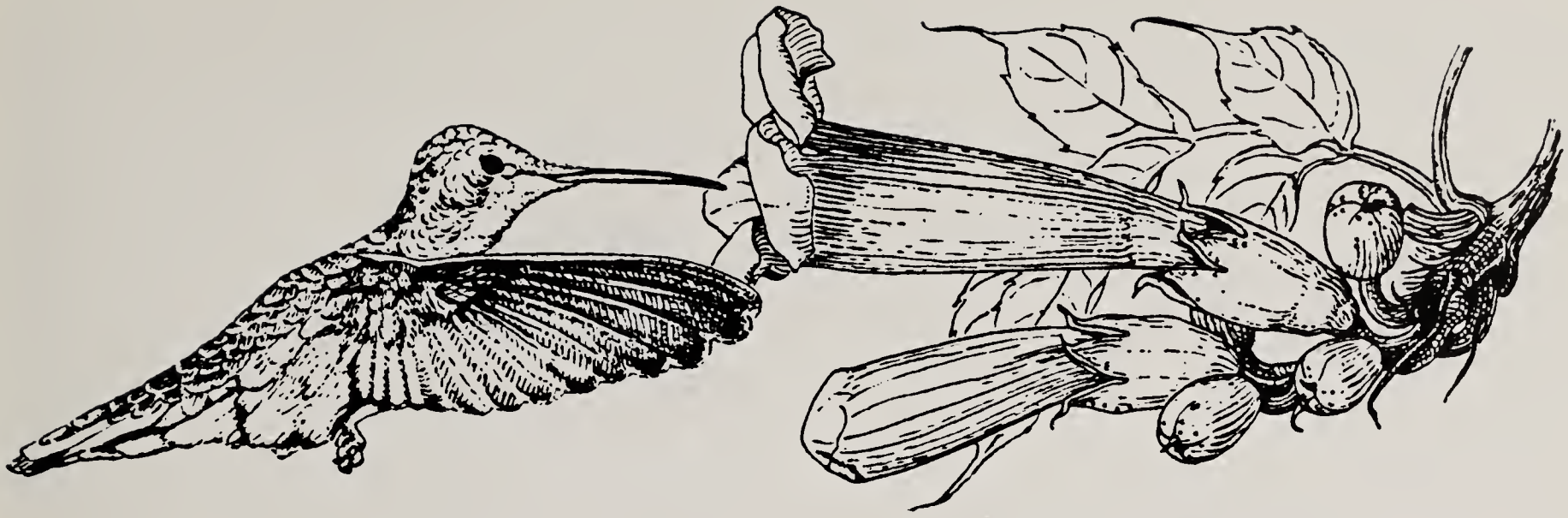
But what would happen to our little hummers during the night, when these visual feeders cannot see their floral targets, if their metabolism were to continue unabated? The hummer's way of solving this problem is to go into hibernation every evening. Its metabolic rate drops sharply, so that by the middle of the night it is only one-fifteenth of the daytime rate. The hummer's temperature now is not much higher than that of the surrounding air, say around 75º F, and the animal is so torpid that it can be picked off its perch like a ripe fruit. Under the influence of a built-in "biological clock," the bird's body temperature begins to rise again just before daybreak, and its rate of metabolism gradually increases. When the sun is above the horizon, the hummer is its old self again, warm and alert and ready to tackle another day. Before the arrival of the Spaniards in the New World, Native American ladies in South America would sometimes speed up the process by keeping the torpid little creatures against their bosoms. Spanish priests later took advantage of this situation to "explain" the miracle of resurrection!

A hovering hummingbird uses up about six times as much oxygen as a resting one. It is interesting that its energy consumation is roughly the same as that of a modern helicopter, close to 750 British thermal units per pound per hour. Flying in a forward direction at the high cruising speed of migrating hummingbirds (35 miles per hour) should not require much less energy. Normally, a hummingbird has no reserve of fuel in the form of sugar or fat, but before a long flight it will stock up on fat, thereby increasing its normal body weight by an almost incredible 50 percent. A human being wishing to give an eight-hour performance comparable to that of a flying hummingbird would have to deposit a layer of fat weighing 80 pounds and live on it throughout the day.

Comparisons have been made between fat content and distance covered for rubythroat hummingbirds migrating from the Southeastern U.S. to their winter quarters in Mexico. A straight-line flight from Florida to the Yucatan Peninsula amounts to 500 miles and whether or not the amount of fat in a hummer's body is sufficient to do the job in one fell swoop is still a matter of debate. Some biologists feel that they move from Florida to Cuba first and then hop over from there to Yucatan. Even so, their performance would be downright impressive. But our own rufous hummingbird is no slouch either! In the summer, this tiny bird, no longer than a matchstick, may be found as far north as Mount Logan in Alaska, close to the Arctic Circle. For this species also,winter quarters are in Central America. To get there, the Alaskan birds must fly along the entire coast of North America covering a distance of 2,200 miles!

Reproductive behavior of hummingbirds

The males of nearly all hummingbird species are genuine Casanovas that take no part in nest building, incubation, or rearing of the young. After having wooed a female with elaborate courtship antics and having mated with her, the male may stay in the vicinity but he will spend most of his time fighting with other males and courting other females. Consequently, hybrids between different hummingbird species are not too rare!



Hummingbird hovering in front of a trumpet-vine flower. From The Story of Pollination, *by B.J.D. Meeuse (1961).*

A mother hummingbird builds her nest while flying. In *Selasphorus rufus*, the most common of our State of Washington hummers, the result is a miniature work of art, a round cup that is a mere one inch across on the inside and has an outside diameter — at its widest point — of about two inches. In Seattle, one may find such a nest, almost unbelievably, as early as the second week of March (Kothenbeutel, 1974). In most cases, it is securely attached to the terminal fork of a tree bough. For the inside, the female bird often uses a soft, cottony material (from willow catkins?), while the outer layers contain a lot of bright green moss decorated with silvery lichen. Cobwebs, pieces of horsehair or thread, and glue from the tongue of the mother bird help to keep the beautifully camouflaged structure tightly together. The two white, thin-shelled eggs are really tiny (the size of navy beans); yet it is true that in proportion to their body weight hummingbirds lay the largest eggs of any bird!

During the incubation period, and after the babies have hatched, the mother bird appears to live mostly on isects. She leaves the nest and comes back again every 15 or 20 minutes but never lands or sits on the nest's edge. In true humingbird style, she takes off and lands in helicopter fashion! Incubation takes a good two weeks (16 days); an additional three weeks are required for the young to reach the fledgling stage. After that, they still have to learn how to obtain their own food so that they can gather strength for the fall migration, probably to Mexico. A molt in their winter quarters will give the young males their respendent nuptial attire. If the hummers are

Salal (Galtheria shallon). *From the book* Field Book of Western Wild Flowers, *by Margaret Armstrong.*

fortunate enough to make their way back to our neck of the woods, the breeding cycle will be repeated the following spring. As Shakespeare has put it so eloquently:

Of Nature's fair we seek increase,
That Beauty's rose shall never die!

A Plant Hunting Trek in Nepal

Part I, The Lower Elevations

TAMARA BUCHANAN & DOUG BENOLIEL

The pre-dawn air was icy still, the sky crystal blue, there were no clouds to be seen. Rhododendron leaves were tightly curled and hanging. A quick look at the thermometer verified what we already knew — it was cold, 15º F. Here we were, in one of the most enchanting places on earth, perched on a ridge 12,000 feet high in the Himalayan mountains of Nepal, watching the sun rise over Mt. Everest and her flanking sentinel, Lhotse.

Our journey began many days earlier and many miles down the trail. We were part of a trek sponsored by the Royal Horticultural Society of England. Billed as "Everest - The Plantsman's Way," it was led by A. D. (Tony) Schilling and his wife, Anne Farrer Schilling. Tony is the Deputy Curator of Wakehurst Place in Sussex, England, the sister garden to the Royal Botanic Garden, Kew. He had already led 12 treks into the Himalayan mountains. For two years he lived in Nepal while he helped to establish the national arboretum of Nepal just outside of Kathmandu. Anne, an acomplished botanical artist, illustrated the most complete volume on the plants of the Himalayan mountains, *Flowers of the Himalaya* by Oleg Polunin and Adam Stainton. Tony and Anne are a delightful pair of plant enthusiasts who were able to provide insight into the flora of this rugged, mountainous terrain.

Our goals were to observe and photograph the flora in its natural habitat and to collect seed from a few of the best plants. Having excellent weather, finding plants with seeds, and being well prepared helped us to succeed in our objectives. Tony's astute knowledge of the plants and their names facilitated the labelling process, which in turn aided the record keeping.

The Himalayan mountains run roughly southeast to northwest along the border between Nepal and Tibet (China). Sandwiched between the two huge nations of China to the north and India to the south, Nepal lies in a latitude equivalent to Florida. The capital of Nepal, Kathmandu, is also its largest city and the site of our first introduction to Nepalese life. Even at 4000 feet above sea level, the climate is tropical; bananas, oranges, lemons, and an assortment of melons can be found in the local bazaars. We quickly learned the rule that if you can not peel it or boil it, do not eat it. Even though this may not always be true, it is a guideline worth remembering for a safe visit.

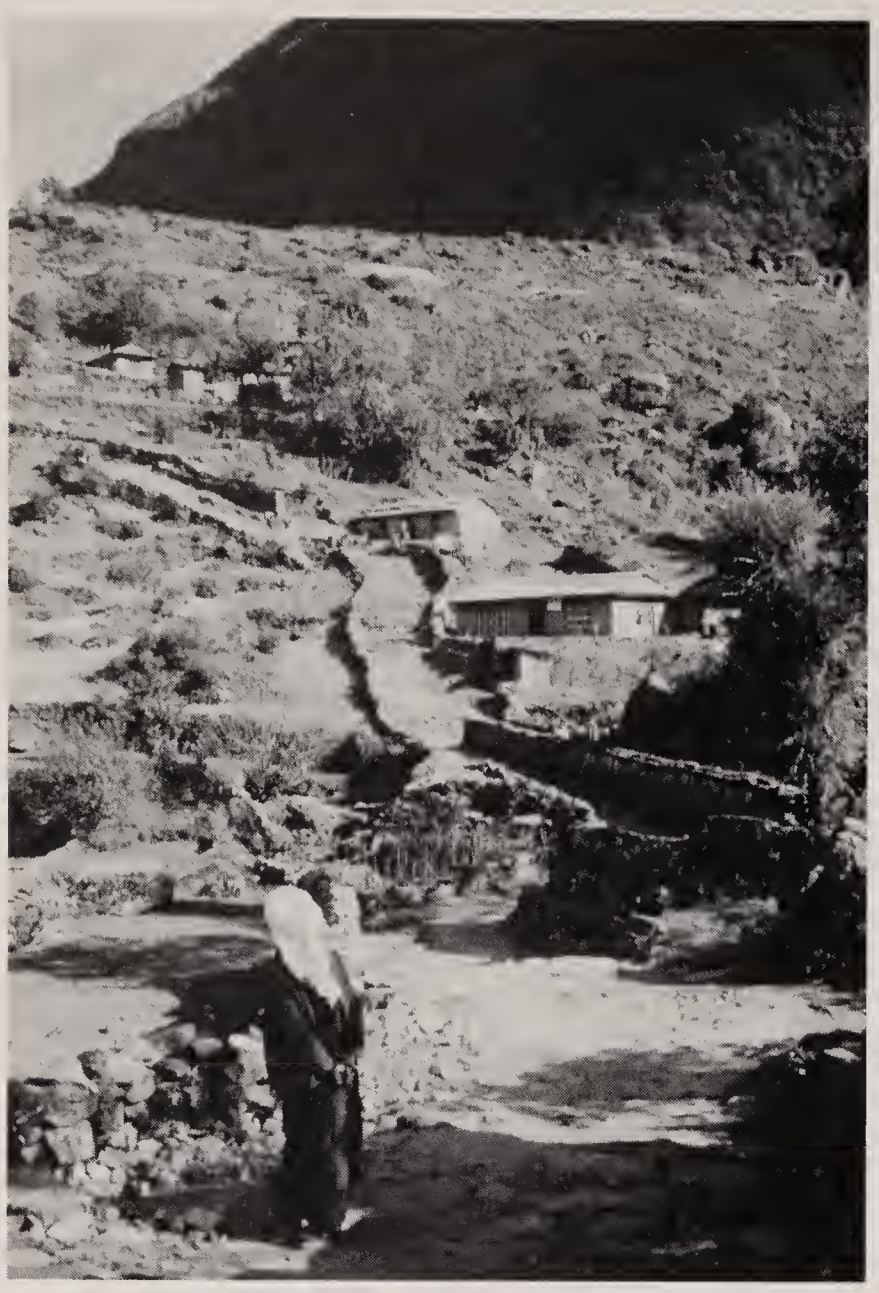
A Nepali woman and child. *photo: authors'*

Our stay of two days allowed ample time for final preparations of our imminent botanical experience. It also permitted us time to enjoy the unusual sights, smells, and sounds of this bustling city. It was enlightening to observe the non-aggressive way the Nepali people related to one another despite the crowded living and working conditions. This kind of relationship allowed us to more fully understand their salutation of "Namaste", "I salute the spirit within you."

We arrived in Kathmandu on October 20, 1985, during the beginning of the dry winter months. Although we experienced only one day of light mist, the visibility was limited while we hiked the lower elevations. Only a couple of times during the first week were we able to view the distant, snow covered peaks, all thousands of feet taller than our familiar 14,000 foot Mt. Rainier. Our link between the city and the trailhead was an adventuresome 10 hour ride in an old, rarely maintained Land Rover. The road started out fair, then progressed to poor, and finally to passable. The small village at the road's end was Jiri at 6500 feet. With courage, hope, excitement, uncertainty and limited gear, we readied ourselves for three weeks of walking and camping in the foothills of these legendary mountains.

The next few days we travelled through the lowlands, fascinated by the local population. These gentle people were equally intrigued by our appearances and activities. The Nepalese are an earthy people whose simple life is intimately tied to the land and guided by their religious beliefs. Since agriculture had been their ancestors' primary means of support, long ago much of the native flora had been cleared from the soil. They built terraces along the steep slopes to facilitate the cultivation of domestic crops. Basically, the same methods of cultivating the soil that were used then are used today. We observed two "tools"; a simple hand hoe and a water buffalo pulling a wooden plow.

The indigenous plants we discovered at the elevations of 6500 to 9000 feet were of only a casual interest to us since they would be hardy in areas generally warmer than the Puget Sound region. At this elevation there were some wonderfully colorful plants that were in full bloom during the warm days of winter.



Trail near Kari khola. *photo: authors'*

Pleone praecox , a rose pink-flowered, epiphytic orchid, was amazingly plentiful, adding much brightness to the dense foliage. A tender cherry, *Prunus cerusoides*, with its sparse, pink flowers occasionally decorated the view from the trail. This is an attractive tree with ornamental possibilities. A third pink flowering plant was *Luculia gratissima* an evergreen shrub with large, clear pink, sweetly fragrant flowers. Being so full of flowers and with shrubs ranging from 5 to 15 feet in height, they could be easily located across valleys. It is as though the color theme for this part of the trek was shades of pink.

In the valleys and on the hillsides a considerable part of the tree canopy was composed of two huge ericaceous shrubs, *Lyonia ovalifolia* and *Rhododendron arboreum*. The former is a gracefully open deciduous tree or, more commonly as we found it, a randomly butchered shrub. The branches were apparently harvested and used as fuel since the leaves and buds are reportedly poisonous to animals. The peeling nature of the bark is similar to that of a semi-mature *Pieris*. The *L. ovilafolia* might be a splendid ornamental in those parts of Puget Sound where the winters are warmest. *Rhododendron arboreum* is also used for firewood. However, we found numerous glens containing old plants, many being greater than 20 feet in height with a trunk12 inches in diameter. One of the largest we came across was about 40 feet tall, 30 feet across, and with a trunk diameter of about 30 inches at 4 feet above the ground. It grew, along with hundreds of others of a lesser size, in a cool, moist draw that was carved into a dry hillside. (Unfortunately for us, this specimen had no seeds.) This widely varied, evergreen tree produces the national flower of Nepal. Our Sherpa guides called it "lali guras." We noted that most of the *Rhododendron arboreum*, which generally have a red or pink blossom at these elevations, had leaves with white indumentum. Only occasionally, at this altitude, did we find leaves with rusty-brown or cinnamon indumentum that is so common at the higher elevations. This rhododendron was a constant companion, being with us at 6500 feet, up and down hillsides through the elevation ranges, and even on an exposed south facing cliff at 13,000 feet.

Other ericaceous, woody plants that we encountered included *Rhododendron triflorum*, *Gaultheria fragrantissima*, *Vaccinium glauco-album*, *Pieris formosa*, and *Gaultheria nummularioides*. The *G. nummularioides* is a tidy ground cover, only one inch high which prospers in protected, moist, shady locales. *Gaultheria fragrantissima*, as the specific name implies, possess leaves that are wonderfully aromatic, much like that of wintergreen. Mature plants, being 2 to 4 feet tall and greater in width, commonly grow in the full sun on river valley hillsides, in well drained soil. This broadleaved, evergreen shrub could make an excellent garden ornamental in the most protected niches of the Puget Sound basin. In the shady protection of the forest canopy, growing in moist soils, were numerous patches of *Sarcoccoca hookerana*. *Rhododendron triflorum* and *Vaccinium glauco-album* also prospered in similar habitats.

A shrub which grew in a drier and sunnier spot was the climbing ragwort, *Senecio scandens*. Much to our delight, its bright yellow inflorescence periodically

Inula hookeri *at 9500 feet.* *photo: authors'*

decorated the trailside. The late summer flowering *Inula hookeri* grew in swampy drainage. On a north facing hillside at 9000 feet, near the Dudh Kosi (river), grew some of this species of *Inula* that had bright yellow, daisy-like flowers while others had seed heads that had bloomed weeks earlier. Think of this plant with its possibilities as a touch of color in a boggy garden swale. The specific epithet, *hookeri*, was given in honor of Sir Joseph Hooker, who in 1848 was the first European to explore botanically this part of the world. A vine-like member of the gentian family, *Crawfurdia speciosa*, draped protected rock-walls with its blue-white, trumpet-shaped flowers.

Other herbaceous perennials that we found were the trailside plant, *Anaphalis triplinervis*, the pink-purple flowered, rambling geranium, *Geranium procurrens*, and *Euphorbia schillingii*. The latter, a yellow-flowering spurge, was named in 1985 to honor our botanical leader, Tony Schilling who discovered this small native plant. We were delighted with *Rubus nepalensis*, which could be a fine garden groundcover. Forming a dense, one-inch thick mat, it appears to be semi-evergreen or perhaps evergreen. It displays small, trifoliate leaves, a white strawberry-like flower and scarlet fruit. In our climate of the Pacific Northwest, the seeds that we have sown have produced hundreds of seedlings, which we will grow and observe. If the species proves hardy, we plan to introduce the best plant into the nursery industry. *Rubus nepalensis* is grown in some gardens in England where it has performed well.

These are but a few of the more interesting plants in the 6500 to 9000 foot hillsides and river valleys of the Dudh Kosi section of the Himalayan mountains. The satisfaction of discovering, photographing and making observations and notes about these plants and their environs was only a start. We had particular interest with the next elevation range of between 9000 and 12,500 feet where many plants thrive that are, or could be, of ornamentalal value in the Pacific Northwest. It is the plants, the people, and the adventures in this region of Nepal that concerns us next in Part II.

Endangered Bulb Alert

Spring is glorious — especially the bulbs that bloom in our gardens. However, a cloud hangs over the splendid display — the threast of extinction. Preliminary information indicates that some of the original, wild species of tulips, daffodils and many other bulbs, the patriarchs of our gardens' glories, could, under current market pressures, disappear forever.

Americans plant over a billion bulbs each year. Most of these are hybrids produced in nurseries, especially by that amazing country, the Netherlands. If the flowers that attract you have such popular names as Baby Moon or Shot Silk, or are identified as hybrids, you should feel free to buy them. However, please be careful about bulbs labelled as "wild," "species," or "botanicals," and many of the small, early-blooming types. These may have been collected from the wild in Turkey, Spain, South Africa, Central Asia, or even the United States.

Surprising as it seems, some of the bulbs most commonly offered for sale may have been wild-collected, despite the availability of propagated plants. Snowdrops (*Galanthus* spp.) is one such type; Turkey exported 28 million of them in 1983, France another 10 million. Turkey also exported between 10 and 13 million winter aconite (*Eranthis hymenalis*) and unknown numbers of grape hyacith (*Muscari* spp.) and *Crocus*

Fritillaria, *from* Bester Hortus Eystensis.

species. In 1986, Turkey exported at least one million *Cyclamen* tubers. Even the crown imperial, *Fritellaria imperialis*, is still collected in Turkey, despite its widespread availability from propagation.

Other types of bulbs that are collected from the wild formerly were sought primarily by specialists, but now are entering the general market. Even old favorites, such as *Narcissus triandrus* var. *triandrus*, "Angel's Tears,"

endangered now through over-collection, are still sold. Unknown numbers of *Narcissus* are being collected in Spain and Portugal; Turkey exports perhaps 500,000 bulbs each year.

Collecting is not limited to the Mediterranean region. The trout lily, or dog-tooth violet, *Erythronium americanum*, is collected from its habitat in eastern North America, then offered for sale "direct from the (Dutch) grower"!

We do not know which species are being forced to the brink of extinction by this trade. However, botanists in Turkey have expressed concern about the trade in snowdrops, giant summer snowflakes (*Leucojum aestivum*), the sea daffodil (*Pancratium maritimum*), two species of *Sternbergia*, crown imperial, *Lilium candidum*, and *Tulipa pulchella* 'Humilis'. British botanists are concerned about these and several other species, including *Cyclamen* and the winter aconite.

Several species of tulip are threatened in their native habitats in Central Asia and the Caucasus Mountains. Included are *Tulipa dasystemon*, *T. schrenkii*, and *T. tarda*. We do not know whether the specimens of these and other tulip species sold in the United States are of wild or propagated origin.

Gardeners who wish to avoid purchasing wild-dug plants face a challenge. Virtually none of the catalogs identify whether the bulbs offered for sale are of wild or propagated origin. Statements that bulbs are "Direct from Holland" are no guarantee of propagation, for that country re-exports wild-dug plants as well as propagates. The cautious buyer must inquire about the origin of each type of bulb that he or she is considering. We suggest that you ask, "Did you propagate these bulbs in your nursery from seeds or offshoots? If you obtained these bulbs from a supplier, do you know that the supplier propagated them?" If the dealer evades the question or cannot answer to your satisfaction, you may wish to avoid purchasing that species from that dealer.

The Natural Resources Defense Council continues to study the trade in wild bulbs. Your comments are welcome. NRDC is a non-profit membership organization dedicataed to securing a safer and healthier environment through scientific research and legal action.

The earliest illustration of a tulip, from Mattioli, 1565, Commentarii, *p. 1244*.

Faith Thompson Campbell
Plant Conversation Project
Natural Resources Defense Council

The University and the Arboretum: The Center for Urban Horticulture's Continuing Education Programs

A commitment to public service and continuing education was one of the prime objectives when the Center for Urban Horticulture was created. With my arrival in April 1981 a public outreach effort was initiated. A large portion of these programs have involved activities held in the Washington Park Arboretum.

Mr. Van M. Bobbitt, Coordinator of Continuing Education, is responsible for the professional horticulture program. This includes a monthly 3-hour ProHort Seminar, aimed primarily at the outdoor landscape maintenance industry. A number of the ProHort seminars involving plant identification, pruning, tree maintenance (arboriculture) have been held in the Arboretum. Mr. Bobbitt also coordinates quarterly newsletters containing columns written by both Washington State University and University of Washington faculty. Recently he coordinated such diverse programs as a "National Soils Seminar for Rosarians," and a quarterly "Interior Plant Maintenance Training Program."

The free public lecture series has been developed by Mr. Bobbitt. A Monday evening plant travelogue has become one of the most popular, often exceeding 100 people in attendance. Many Arboretum Foundation members have shared stories of their travels. The Wednesday morning series features topics on specific plants, whereas cooperative efforts with King County Master Gardeners have resulted in Friday evening and Wednesday noon Brown Bag lectures. In an extension of cooperation, the Master Gardeners were present both Saturdays and Sundays at the Graham Visitors Center last summer. They will continue being there on Sundays into winter, 1988.

Each graduate student in the continuing education program has been involved in supervising the urban horticulture courses. Presently, Mr. Thomas Kuykendall, a CalPoly graduate, is responsible for creating public courses and publicizing the Center's entire schedule of events. Our mailing list now includes over 6,000 names, all requests within the last 6 months.

Our horticulture courses cover diverse horticulture topics from native plants, edible gardening, bedding plants, and landscaping to plant photography. Such courses as pruning, native plants, and plant identification all meet in the Arboretum in order to take advantage of the Arboretum's diversity.

Many of our activities are now the responsibility of the program assistant at the Graham Visitors Center. Guided tours led by an ever increasing group of volunteers, most of

whom are dedicated Arboretum Foundation members, continue to be one of our most popular activities. During 1986, those volunteers led nearly 300 tours, mostly to elementary school children and horticultural groups. Our Sunday-at-One tours were so popular that we have extended them into every month of the year, except December. Attendance often reaches 75. We have held advanced training through "Project Learning Tree" and "Project Wild," from which guides learned many new and innovative tour techniques especially applicable to children's groups. The Arboretum offers a diversified outdoor laboratory for teaching many things relating to our environment. The "Special Introduction for High School Science Teachers" and the Unit Council's "Saplings" program will bring more groups in the future.

Under the direction of Dr. Clement Hamilton and Timothy Hohn, the "plant materials" faculty and staff have spent extensive time in assessing the future for all of our plant materials courses. The collection policy, being developed through Mr. Hohn's directions, has also helped us develop new courses. The Autumn 1986 "Nature Into Landscape" course attracted nearly 40 people who learned about plants from winter-rain climates of the world, many of which are grown in the Arboretum. Additional courses, such as "Botanizing in the Arboretum" with much field experience, have been scheduled. Many of these have been written up in great detail in previous *Arboretum Bulletins*.

The Graham Visitors Center has provided a much needed facility for more Arboretum programs. Through the generosity of the Arboretum Foundation Unit Council and new volunteers, we have been able to open the Visitors Center on Saturday and Sunday afternoons. The Arboretum facility is designed to be as self-supporting as possible. Consequently, rental fees and policies have been established through the cooperative efforts of the City of Seattle, the University of Washington Center for Urban Horticulture (which manages the Graham Visitors Center), and the Arboretum Foundation.

Other aspects of the public outreach program include our Speaker's Bureau, now

Jan Pirzio-Biroli leads an Arboretum training session of volunteer guides. *photo: John Bolivar*

listing 75 topics, many of which are concerned with specific plants and areas in the Arboretum. A growing number of Arboretum Foundation units have taken advantage of this Arboretum service. Our collection of 10,000 slides, now housed in the Continuing Education office has been cataloged, entered on the computer for ease of retrieval and is now available for public use. The Miller Horticultural Library now offers the largest collection of horticultural books and periodicals in the Northwest. Librarians and their staff are available daily to answer question over the phone or in person. The public is welcome to browse the collection and use the materials while in the library.

The public outreach program reached thousands of Puget Sound area residents and visitors in 1987. We shall continue to strengthen existing programs as well as develop new programs in 1988. We acknowledge the continued support of all horticultural groups and their members, especially the Arboretum Foundation, its supporting Units, and the members who devote untold hours in order to make so many activities possible.

-John A. Wott

An Ecological History of Old Prairie Areas in Southwestern Washington

ESTELLA B. LEOPOLD

Department of Botany and College of Forest Resources, University of Washington.

Mud layers read like pages in a book to students of fossil pollen, and every proper lake is a local library of information on past vegetation. In western Washington fossil pollen tells the story of vegetation development and climate change since the time when continental glaciers stood 3000 feet thick near Olympia. The romance of a lost biome dominated by ice-age mastodons, and a warmer time when prairie Indian cultures were in their heyday can be inferred from fossil evidence, and can be read between the lines of the pollen story.

In the Pacific Northwest botanist Henry Hansen at Oregon State University was the first to explore the composition of post-glacial pollen preserved in bog and marsh sediments. Armed with his peat corer, he found a forest sequence faithfully repeated in coastal lowland sites: the earliest postglacial pollen seemed to be dominated by lodgepole(?) pine, followed by Douglas fir and more recently by western hemlock. The work of Calvin and Linda Heusser (New York University) and Cathy Barnosky and others at the University of Washington (i.e. Leopold et al. 1982; Tsukada, 1982) extended this record and provided new details. By penetrating old explosion craters north of Vancouver, Washington, Barnosky (1985) and the Heussers (1980) have described long pollen sequences. A particularly detailed record comes from a 15-meter sediment core at Battle Ground Lake (Lewis River drainage) where Barnosky identified fossil bracts and needles to complement the pollen data. Positions of identified macrofossils are marked with dots in her pollen diagram (Fig. 1).

In western Washington when ice of the last glaciation draped the landscape north of Olympia (about 18-15,000 years ago), an odd mixture of herbs, shrubs and conifers comprised an open type of vegetation near Vancouver: abundant grasses with *Polygonum bistortoides*, *Valerianella* and *Sanguisorba* suggest mountain tundra-like habitats. Sagebrush, which was fairly abundant, suggests summer-dry, perhaps steppe-like conditions.

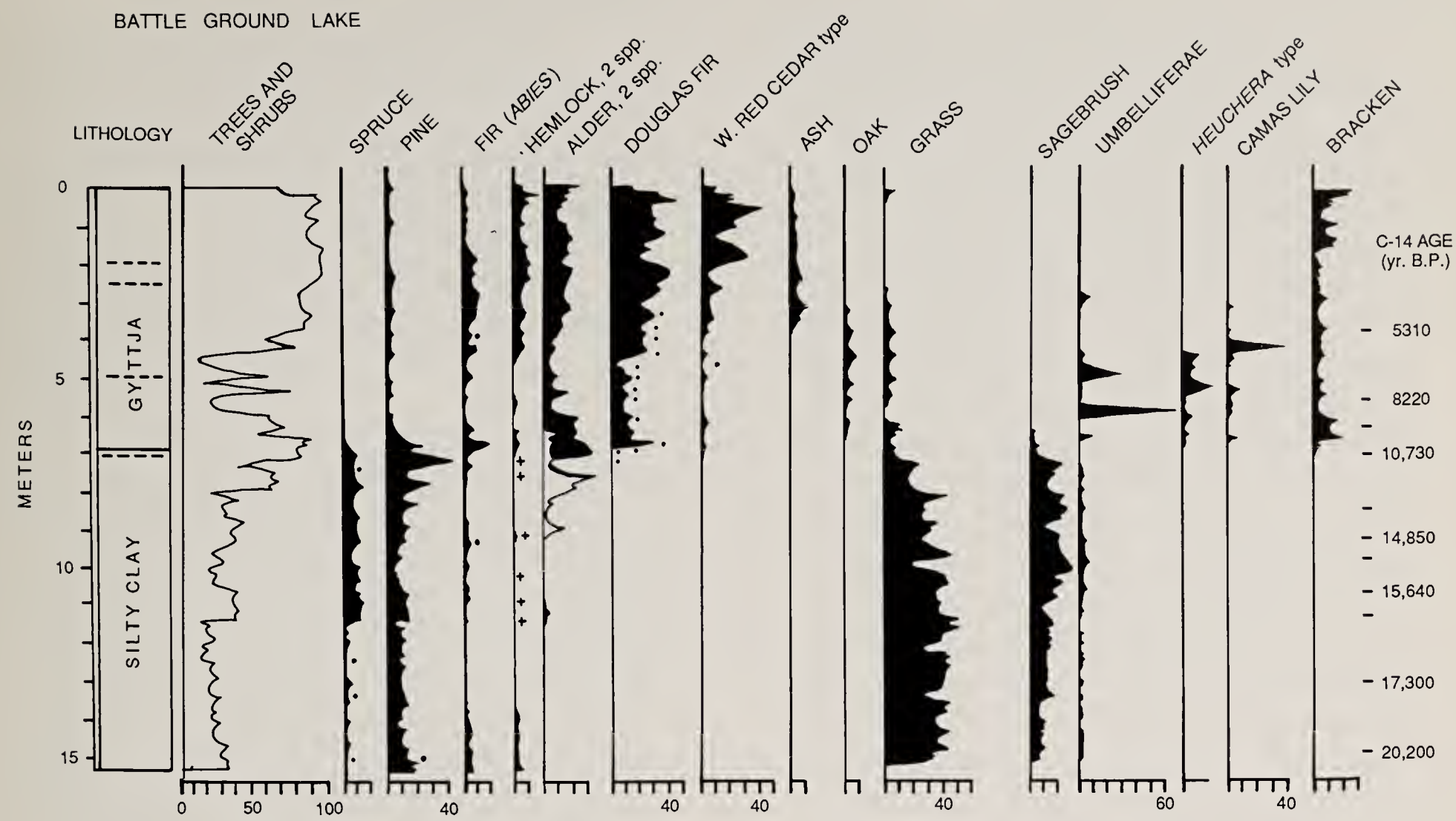


Figure 1. Pollen percentage summary diagram, Battle Ground Lake State Park (after C. Barnosky, 1985). + indicates mountain hemlock pollen. Dots show position of macrofossils identified. Not all C-14 dates are shown.

Lodgepole pine, that cosmopolitan tree which invades disturbed areas, was associated with spruces, probably including Rocky Mountain and Sitka spruce, and firs (Pacific silver fir and/or grand fir). The dominance of diverse herbs and shrubs suggest a parkland tundra with spruce as the major tree species. Initial vegetation might have resembled modern high-altitude communities east of the Cascade crest.

As continental ice began to melt (15-11,200 years ago), some temperate plants appeared and tundra types were gone. Mountain hemlock, Sitka alder, lodgepole and perhaps ponderosa pine appeared and increased; vegetation became more luxurient (based on increased pollen abundance), and diverse herbs and sagebrush were still present. Barnosky interprets this as parkland with little evidence of tundra plants. This vegetation suggests cool and more humid conditions south of the retreating ice sheet.

Early man saw this landscape; a broken "spear point" embedded in the rib of a mastodon bears witness to man's probable hunting activites near Sequim, Washington, some 12,000 years ago (Peterson et al. 1983). There the pollen mix was similiar to that at Battle Ground Lake. Other extinct megafauna are recorded at Sequim (bison, caribou) and in the coastal region, i.e. at Beacon Hill, Seattle (D. Mullineaux, USGS data), and Hillsboro/Portland, Oregon (A. Barnosky data).

Western hemlock and red alder arrived in the Vancouver area by 11,000 years ago, and according to Barnosky's data these were soon followed by many temperate types including Douglas fir about 10,500 years ago. The earlier absence of Douglas fir in southern Washington has lead to discussions on where this tree was during the full glaciation. Barnosky feels it was probably eliminated from the area north of the Columbia River, but the tree came back about 16,000 years ago just after the full glacial period. Then there is no record of it until ca.11,000 years before present (B.P.) when it spread virtually all the way to the Canadian border by 10,000 years B.P (Tsukada, 1982).

With the postglacial warming, Douglas fir quickly became the dominant tree in the western Washington lowlands where it was associated with an abundance of two successional species, red alder and bracken fern. These forests also contained western hemlock, probably grand fir, poplar, and white pines. The successional plants connote frequent fires and suggest open forests or forest

in a mosaic with prairie patches.

In southwestern Washington, however, the vegetation was more savanna-like, particurlarly between 9500-4500 years ago; Douglas fir and oak were the main trees associated with prairie and meadow grasses, camas lily, *Polygonum*, and various Compositae. Sporadic pollen peaks of camas lily, Umbelliferae, and *Heuchera* type suggest prairie plants flourishing periodically, perhaps after local fires. Bracken was widespread and abundant. Farther north prairie existed on local outwash plains, for example, near Nisqually Lake. During this warm, dry interval *Chrysolepis* (*Castanopsis*) expanded its range as far north as Seattle, and it became abundant in the southwestern part of the state. (At present *Chrysolepis* is endemic along the Columbia Gorge, and has only one outlying relict stand on the eastern side of the Olympics.) During this early interval when the climate was a bit warmer and/or drier than now, it is probable that the rich black prairie soils of southwestern Washington began to develop. Associated with the prairie biome were the developing Indian cultures of southwestern Washington.

Between 4500 years ago and the present, a climatic cooling brought an increase in many conifers near Vancouver: Cupressaceae, (probably western red cedar), Douglas fir, western hemlock, ash and others, while oak and prairie herbs and grasses declined. These data show that conifer forest expanded at the expense of grasslands in southwestern Washington; in the northern Puget Lowlands forest composition shifted toward an increase in moisture-loving trees; especially notable was the rising importance of western red cedar.

Historical records come from sediments in a short core from the upper 16 cm of sediment at Battle Ground Lake; here pollen suggests at least two intervals of disturbance following settlement by Europeans. The first may have reflected logging outside the crater; weeds such as *Rumex*, *Ambrosia*, and also bracken fern increase to about 17% of the pollen/ spore count. A second episode at 12 cm below the top of the profile records a drop in total tree pollen, particularly of Douglas fir, while grass, bracken fern and plantain increase. This change may reflect logging or deforestation that took place inside the crater in the first part of the 1900's.

The sediment record of plant pollen and macrofossils tells a story about vegetation that cannot be obtained in any other way. Admittedly fuzzy, it is still better than other lines of available evidence in outlining the general changes in landscape.

Embedded in the pollen story are some changes in the land probably wrought by the Indians who occupied the valleys for thousands of years. There can be no doubt that the cultural practices of the human community had some impacts on the local vegetation. For example, the Cowlitz and Chinook Indians who lived in the area around Battle Ground Lake and the southwestern Washington region are known historically to have encouraged prairie plants by their practices of regular burning. They lived along the Cowlitz, Lewis, and Kalama Rivers, where they fished for salmon. These Indians used to travel down to the mouth of the Columbia, where fishing was better. They had names for every praire along the way and they visited them in late summer to collect camas lily roots, which they dug with sticks. They made a practice of "burning the prairie every two years." (Adamson, 1926). They "had to travel far in the hills for black berries", huckleberries, and blueberries, where they also hunted deer, bear and other game. To encourage the berry crop they "burned the hills every two years". Cowlitz Indian, Mrs. Youckton, who was born at Cowlitz Prairie about 1865 said, "there used to be prairie all the way from Olympia to Tenino and Centralia" (Adamson, 1926).

The Cowlitz depended on a number of plants associated with prairie habitat: wild rhubarb which grew at the prairie edge, wild carrots and camas lily ("lackamas") were collected on prairies in late summer and baked. Some camas bulbs were huge — up to two feet deep! Small tiger lily of the prairie has nutritious bulbs that were gathered in fall, and boiled in water. Wild yellow sunflower roots were eaten in summer and fall. From under the white oak trees at the prairie edge, the Indians gathered acorns in fall; they cooked these all night on hot rocks in a pit (Adamson, 1926). The Cowlitz economy depended on this diverse productivity of prairies, and they enhanced the abundance of these species by use of fire.

After the Spaniards introduced horses in Washington in the 1700's the Cowlitz became highly mobile equestrians, as did the Klickitat who moved into the Cascade foothills after 1830 (Ray, 1966). These tribes were exceptional among the Indians of southwestern Washington in that the horse enhanced the mobility of these peoples. Their use of the horse suggests that the vegetation of this area was substantially open — at least with a mosaic of prairie and forest.

The present landscape of the Battle Ground Lake area is agricultural; conifer forests have expanded into many former prairies, probably because burning by Indians was brought to an end before 1900. A Douglas fir forest still grows on the rim of the crater, but it is nearly all young timber. The Cowlitz are confined to a small reservation along the Cowlitz River. European man has written a new message across this landscape, and has reshaped the biota to suit his changing needs; it is unfortunate that so many species have been extirpated in this process. Prairie communities are now so rare they badly need protection as well as prescribed burning. The Cowlitz and the new Washingtonians are a part of a linear history in which each has consciously restructured their landscape.

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H.B. Tukey Receives Morrison Award

Dr. H. B. Tukey, Jr., Director of the Center for Urban Horticulture and Washington Park Arboretum at the University of Washington, has received the 1987 B.Y. Morrison Lecture and Medal Award. The award is presented annually by the United States Department of Agriculture to recognize outstanding contributions to the environmental sciences.

Dr. Tukey's Morrison Lecture, entitled "Plants for Cities — A New Era for Horticulture," was delivered on July 12th before the Ohio Florist Short Course in Columbus, Ohio. The talk focused on the adaptation of plants to city environments and described worldwide cooperative efforts to improve knowledge of urban plants and of their effects on people.

The Center for Urban Horticulture, which Tukey has directed since 1980, is the first academic program in the United States to combine research, teaching, and public service on the use of plants in urban environments.

The Morrison Award was started in 1968 to honor the first director of the U.S. National Arboretum in Washington, D.C. B.Y. Morrison (1891-1966) was a horticulturalist, landscape architect, plant explorer, author and lecturer. Best known for his work with the Glenn Dale azaleas, he fostered broad international exchange of ornamental plants. Each year a different scientific or professional meeting is chosen to host the prestigious Morrison Lecture.

Marshall Island Vegetation and the United States Nuclear Weapons Testing Program Part II

S.P. GESSEL and R.B. WALKER

Part I of this article appeared in the Spring, 1987 issue of the Arboretum Bulletin. The authors discussed atoll environment, soil and vegetation of the Marshall Islands. A brief description of the weapons testing activities was given as well as a history of the islands. This article will compare specific instances between the period of 1960 and 1986 and will draw conclusions about the effect of the United States Weapons Testing Program on the vegetation of the Marshall Islands.

1960 - 1986 Comparisions

During the past 30 years there were some typhoons, but no catastrophic storms which greatly altered the islands. The destructive influence was all related to weapons testing and came from construction activity or the heat and blast effect of nuclear explosions. We use five different areas on Rongelap or Bikini to illustrate the recovery of vegetation in this environment. Photographs taken in the early period will be compared with those of 1986, shot from the orginal photo station or as close as we could approximate it. We did not make detailed plant inventories in the short time we had in each area in 1986. However, we believe the photo comparisons show the differences. For each location we describe the degree of initial disturbance, the initial soil condition, and the plant cover at both periods.

Bikini Island

The 1964 photo was taken from an observation tower which was removed in the late 1960's cleanup. The 1986 photo was taken at approximately the same location on the island but within a coconut plantation.

The 1964 condition shows that the vegetaion was highly disturbed by contruction and fires from some of the tests. The original coconut plantation was essentially destroyed. The photo looks across a fertile soil area of the island now covered with shrubby vegetation, largely *Scaevola*, but with *Tournefortia*, *Cordia* and *Dodonaea*. Soils were mature, with good organic matter, largely undamaged by any of the testing and construction, but with radioactive fallout.

In the late 1960's Bikini Island was cleared of all testing structures as well as vegetation. Coconut plantations were established over the island wherever possible in preparation for the return of native people.

Top: Bikini Island in 1964,. Bottom: same location in 1986

Coconut tree on Rongelap Island, 1964.

Same tree in 1986.

Homes and roads were constructed.

Because of radioactivity in the food plants growing on the island, the natives were removed in 1977. The coconut plantation was allowed to grow and is now the dominant vegetative feature of the island as the photo on page 19 depicts. There is considerable encroachment of native species such as *Scaevola*, *Cordia*, *Dodonaea* and *Pisonia* into the plantation. Efforts are now underway to remove the radioactivity so that usable food plants can be grown. These efforts will be described in a later section.

Coconut plantation — Rongelap Island

Rongelap atoll and island was affected by a light radioactive fallout but no physical destruction. People have inhabited the area, except for removal from 1954 to 1957, receiving a substantial portion of ther food supply from plants and fish. Green Peace removed the people in December of 1985, so the area was uninhabited at the time of our 1986 visit.

The area selected for comparison is in a well established coconut plantation. The trees were probably planted under Japanese occupation, although some may date to German times. The plantation has been actively managed for copra production and is close to the Rongelap village. This comparion is made to give the reader a view of systems which have had little disturbance and only normal native management.

The area is on the widest part of Rongelap Island with stable, more mature soils, rich in organic matter and nitrogen. As in all of the northern Marshall Islands, vegetative cover fluctuates from the wet to the dry season and, therefore, the general understory will look different in July (wet) than in February (dry). Except for trails or small cultivated patches, the soil is entirely covered by grass (mainly *Lepturus*) and a vigorous growth of *Tacca* in the wet season.

The before and after photos (taken by Dr. Walker) shows Dr. Gessel standing alongside the same coconut tree. The coconuts have obviously grown and there has also been some redistribution of stems. The human subject has also aged but otherwise there are no great changes evident in the vegetation.

Fox Island

This is an island on Bikini atoll which was severly affected by weapons testing. The original vegetation cover was almost totally destroyed and most of the top soil lost. Depressions were created by construction and blast activity through consolidated beach rock. These have filled with salt water with some dilution from rain.

By 1964 when we first viewed the

Cistern area on Kabelle Island in 1986.

island, some vegetative recovery had occured and there was a scattering of *Tournefortia* shrubs. In 1986 the island had a complete cover of shrubby vegetation, mostly *Scaevola* and *Tournefortia*. The pond was well stocked with fish and they seemed to be doing very well.

Cistern Area — Kabelle Island

In the 1954-64 period we chose Kabelle Island at the northern tip of Rongelap atoll for a series of ecological investigations and collections. Kabelle was about 30 miles by sea from the main population center with no permanent residents. The island was only visited periodically for collection of its birds for food by the natives and therefore the plants were not generally disturbed.

The United States had built a water collecting cistern on the island in 1957. At the time of establishment this cistern was in a fairly open environment near the edge of a mature vegetation community. As we usually camped near the cistern, the area became the locality for a number of soil and plant studies and sequential photograhps. In 1958 vegetation around the cistern was quite scarce. By 1986 it was impossible to see the cistern from the older photo points because of vegetation development.

Namu Island

Namu Island is the third largest island, after Bikini and Enyu, of the Bikini atoll. Prior to the testing program it had established coconut plantations on well developed island soil. It was visited frequently for food collection and may have also beenan area of residence for a few people.

Activities associated with the testing destroyed all of the vegetative cover and modified the soils of the island. There was a great deal of construction activity, including building of concrete bunkers. One of the test shots totally destroyed one end of the island.

We first visited the island in 1964.

Namu Island, 1964, with ground cover of Ipomea.

Shrubby vegetation as seen on Namu Island in 1986.

The effects of the testing were very evident. Woody plant cover was rather sparse, consisting mostly of scattered *Tournefortia* up to 4 feet in height with a few *Scaevola*. A dominant feature of the vegetation was a heavy ground cover of *Ipomea* over much of the surface (see above photo). Birds were abundant and nesting in the *Tournefortia*.

In 1986 the island was completely covered with a dense growth of shrubby vegetation, mostly *Scaevola*, but with *Tournefortia*, some *Pisonia* and other species. Traverse of the island was only possible by cutting trails through the brush. *Ipomea* was still evident in some areas but generally was much reduced in area and vigor. The photo taken from the top of a bunker shows the extent of the 1986 plant cover.

The ingrowth of *Pisonia* and coconuts indicates that the island vegetation is fairly quickly returning to a pre-testing status. Soil pits on the island shows that the original top soil was covered with coral detritus in many places but not totally destroyed or removed. The availability of this nutrient rich soil layer fairly close to the surface accounts for the more rapid develpment of vegetation as compared to areas of fresh coral.

Rehabilitation Efforts

Many kinds of changes and developments are taking place to make Bikini Island a hospitable place for humans. A principal concern and effort is removal of radioactivity, primarily cesium and strontium from the soil system and thus from the food chain.

Elements such as cesium, strontium, calcium and sodium are normally held in the soil by charged particles of colloidal size. These elements are subject to removal from these particles by an exchange or replacement process. Some elements are held more tightly than others but any of them can be removed by flooding the system with an excess of a particular element.

The mechanics of this exchange process suggest three ways to remove the radioactive elements if the proper system can be set up.

*Add other elements in excess through fertilizers and leach the removed elements from the system by normal rainfall in the wet season. We experimented with this approach in several areas in the 1960's using potassium fertilizers and achieved some success.

*Add excess of sodium through leaching with sea water. This will remove radioactive elements into the ground water with eventual dispersal. However, it leaves the soil sodium-saturated so that other reclamation is needed. This could come from normal leaching by rainfall in the wet season or by irrigation with fresh water if a supply were available.

*Removal of the top soil horizon, high in exchange capacity because of organic matter, and therefore the location of most of the

radioactivity. This is also the fertile soil layer so that this is a destructive method, and other reclamation steps of adding essential elements and building up organic matter are necessary. This procedure is now under test at Bikini.

Effect of Radioactivity on Plants

Many general comments have appeared relative to the effect of radioactivity on the morphology of plants in the Marshall Islands. There certainly is a wide spread belief that aberrations such as multiple headed coconuts and general distortion of many plants occured. Throughout all of our visits we made specific attempts to observe any plant growth abnormalities encountered. We did observe two multiple headed coconuts but the trees were too old to have the development ascribed to radiation. We did observe some thickened stems (fasciation) on *Ipomea* plants in certain populations. However, this feature often occurs in most populations of this genus from bacterial infection and we could only make limited observations. We conclude that any effect produced by the radiation which would result in obvious morphological changes was very short-lived and not detectable in our surveys.

Conclusions

The effects of the United States Weapons Testing Program on vegetation of the Marshall Islands varied greatly and was related to the construction activity or proximity to a test. Effects varied from total removal of vegetation by construction or fire and blast, to damage by fire. We saw little evidence of direct radiation effect.

Recovery of vegetation in the period of 1964-1986 appears to be related to the severity of the original destruction, and especially to the state of the soil system. Areas on which a fertile soil was retained have returned to dense stands of vegetation naturally, or have been replanted with coconuts as on Bikini and Enyu islands. Areas with almost total removal of soil have recovered slowly but now have substantial vegetation cover, and bird populations have returned which accelerates the soil nutrient building process.

Book Reviews

Encyclopedia of Ferns: An Introduction to Ferns, their Structure, Biology, Ecomonic Importance, Cultivation and Propogation. By David L. Jones. Timber Press, 1987. 433 pages. price $50.00

Up to this time enthusiastic fern fanciers have had to collect numerous books written for specific geographical areas or environments to satisfy their more generalized needs and interests. With few notable exceptions the chasm between highly technical botanical works and those of a horticultural bent was formidable and only the fanatic hobbyist or serious horticulturalist bridged the gap. David Jones has produced an introductory volume encompassing a complete range of information on tropical and temperate ferns designed for the novice as well as the serious professional.

This hefty tome begins with an extensive introduction to the botanical structure of ferns which leads appropriately to sections on the cultural requirements, pests, diseases (and other ailments), propagation, hybridization, specialized culture, repotting, containers and housing. The last half of the text is devoted to descriptions of garden ferns. Not only are the color photots in this volume beguilingly sumptuous but they are extremely precise. Many black and white photos enliven the explanatory chapters, yet it is the exceptional line illustrations used copiously throughout the book with which I am most taken. These fine drawings are particularly valuable in the section on fern structure and reproduction where meticulous microscopic scrutiny is involved.

The final section enumerates over 700 species which have been grouped together by familial alliance or cultural requirements. This is what makes this book an invaluable reference tool for the avid gardener. Each individual entry begins with a short-hand key denoting geographical distribution, frond length (including shape or division), growing regions, and ecological preference (terrestrial or epiphyte).

Blechnum spicant.

A short paragraph describing each fern and its cultural requirements is followed by a list of well-known cultivars.

The only fault I have found with this volume has to do with cultivar information of British ferns. Mr. Jones has included one instance of the very obscure and little known botanical variation *Polystichum aculeatum* var. *cambricum*, as a cultivar, *Polystichum aculeatum* 'Cambricum'. But that is a minor puzzlement compared to the inconsistent and oft-times inaccurate information on the fertility of British cultivars. I find confusing the haphazard listing of the fertility of some cultivars and not others. Perhaps only sterile, or partially sterile, forms should be pointed out with the assumption that the remaining are fully fertile. There are some inaccuracies, such as the listing of two well-known, fully fertile *Athy-*

rium filix-femina forms, 'Congestum cristatum' and 'Cristatum', as partially fertile and the histoically spore-chary 'Plumosum' as fertile. Perhaps these discrepancies reflect the difference in cultivar material grown in Australia versus that in Britain and the United States. However, since this is only the first of a three volumes planned to delve into fern groups and species worthy of cultivation there is time for some international exchange of knowledge and experience.

Judith I. Jones

The "Plant Hunters" series of reissues by Cadogan Books, London: **A Naturalist in Western China**, by E.H. Wilson, 1913 (reprinted 1986), 229 pages; **The Dolomites**, by R. Farrar, 1913 (1986), 207 pages; **Rainbow Bridge**, by R. Farrar, 1921 (1986), 383 pages; **Mystery Rivers of Tibet**, by F. Kingdon Ward, 1923 (1986), 316 pages; **Plant Hunting on the Edge of the World**, by F. Kingdon Ward, 1930 (1985), 383 pages. Published by Timber Press, Portland, Oregon. Each volume $9.95.

How did famous plant hunters conduct their expeditions? What sort of information did they note about the species they collected in the wild for introduction into cultivated landscapes? Were they horticulturalists in outlook, explorers, or botanists, or anthropologists? These are just three of the questions one can ask of the books in Cadogan Press's "Plant Hunters" series, a set of reprintings of original classics by several of the most famous plant explorers. A modern review of these would seem to be presumptuous at first; but I hope to illuminate a few differences in approach used by the three authors.

My first observations concern the new editions themselves. They are sturdy paperbacks, comparable to Dover reissues, and should hold up well. The five are faithful reprints with short new introductions by Geoffrey Smith. Smith has put each book into the context of its author's life and often offers generalizations regarding the explorer's personality as revealed in his writing. I wished for much more, however. Many Asian place names that were landmarks at the turn of the century are now difficult to track down in a modern atlas, and that difficulty is compounded by differences in transliteration between then and now. It would have taken some work, but a careful retracing of the explorer's paths on a modern map, and even discussions of what a traveler would find there today, would have increased the books' reference value tremendously. Annotation of species names that are now in synonymy would also have made their references more meaningful. But these are objections of the "what if?" variety and should not detract from the current intrinsic value of the books themselves.

E.H. Wilson wrote *A Naturalist in Western China*, first published in 1912, after four expeditions; two for the Veitch nursery and two for Arnold Arboretum. The first of the two volumes, combined in the new edition, comprises a series of journey accounts in which Wilson discusses not only the plants but also the geology and especially the people of the regions. Most of volume two could have been subtitled "Plants and Man;" after a concise but excellent account of the vegetation and flora of western China, he treats the plants as they are used by natives for timber, fruit, medicine, ornament, agriculture and tea. Four chapters on game birds and animals seem odd here, but it is a further reflection of Wilson's anthropological bent. In short, a modern reader will find interesting tidbits about plants now familiar in the garden and a good deal more.

Wilson's straightforward unadorned writing is in marked contrast to that of Reginald Farrer, author of *The Dolomites* (1913) and *Rainbow Bridge* (1921). Being a devotee of the sinewy school exemplified by Hemingway, I was apprehensive upon reading the first sentence in the earlier book: "King Laurin's Garden is a land of magic, enclosed by peaks like frozen flames." Soon, however, I was caught completely in his expressively wordy web reminiscent of Poe. Farrer relates his travels with immediacy that beckons his readers to follow; and it was only after many pages that I realized there was almost no mention of plants! In fact, only 45 plant names are found in the index of *The Dolomites*. *Rainbow Bridge*, which recounts his trip to Kansu, China, is a good deal more plantsman-like and loses none of the charm of its predecessor.

Last in chronology, but first in my esteem, are two books by F. Kingdon Ward: *Mystery Rivers of Tibet* (1923) and *Plant Hunting on the Edge of the World* (1930). Ward recounts graphically the actual course of his travels, his dealings with natives, the geography and vegetation of the areas, and the individual plants themselves. The second book is especially strong in natural history and, along with Wilson's, offers observations from the wild that are useful to cultivators of plants. *Plant Hunting*, with accounts from Burma and Assam, deserves to be regarded among the elite natural history travel books such as Alfred Russel Wallace's *The Malay Archipelago* (1869; reprinted 1962, Dover) and Thomas Belt's *The Naturalist in Nicaragua* (1874; reprinted 1985, U. of Chicago Press).

So which of these should you read and/or give to horticulturally inclined friends? For only ten dollars apiece, "all the above" is a suprisingly affordable option. For plantsmanship and natural history, Ward and Wilson are the best bets; for truly entertaining travel writing, Farrer is the obvious choice. Perhaps the most reasonable, if underhanded, strategy is to buy them all now to read before bestowing them as Christmas presents (an old graduate student trick).

New On The Shelf

of the Elisabeth C. Miller Library

VALERIE EASTON

Taylor's Guide to Annuals; Bulbs; Ground Covers, Vines & Grasses; Houseplants; Perennials; Roses; Shrubs; and Vegetables & Herbs. Houghton Mifflin, Boston, 1986.

Based on the 4th edition of Taylor's Encyclopedia of Gardening (1961), this new 8-volume set is a useful reference for home gardeners. The volume on annuals has nearly 200 pages of excellent color plates arranged by flower color. These are more than pretty picture books, however, with each volume containing a chapter on basic botany, descriptions and cultural information arranged in an encyclopedic format, and excellent appendices on subjects such as garden design, pests and diseases, and seed sources.

Gardens for Children. Tigger Wise. Kangaroo Press. 1986

With such an appropriate named author and publisher, how could this book miss? The author really understands kids, as shown in the chapters "Plants to DO Things With" and "Things Children Like (and Don't Like) About Everyday Gardens." A fun and imaginative guide to planning a garden in which a child can play, learn and explore.

Fragrant Gardens. Jane Taylor. Salem House, Boston. 1987

Season by season, the reader is given ideas for bringing fragrance into the house and garden, from the violets of spring to *Hamamelis mollis* and honeysuckles of winter. Color photos, plant lists and suggestions for landscaping give ideas on how to incorporate scented plants into the garden.

Other New Books

Adams, James. *Landscaping with Herbs*. Timber Press, Portland, 1987.

Bloom, Adrian. *Conifers For Your Garden*. Floraprint, Ltd., Nottingham.

Douglas, William L. *Hillside Gardening*. Simon & Schuster, New York, 1987.

Fenderson, G.K. *A Synoptic Guide to the Genus Primula*. Aleen Press, Lawrence, Kansas, 1986.

Hobhouse, Penelope. *The National Trust: A Book of Gardening*. Little, Brown & Co., Boston, 1986.

Titchmarch, Alan. *The Rock Gardener's Handbook*. Croom Helm, London, 1983.

In The Arboretum

Tim Hohn, Curator

The Arboretum is very fortunate to have Christina Pfeiffer join the staff as Horticulturalist. This position, formerly "Grounds Supervisor," was made available by the retirement of Richard Hart earlier this summer.

Chris is a recent graduate of the Center for Urban Horticulture with a Master of Science degree. Her thesis: "Analysis of Landscape Design and Maintenance Requirements in Urban Parking Lots," is indicative of her interest in plant care and design approaches that facilitate preventative maintenance. Chris also received a Bachalor of Science degree in Landscape Horticulture from Michigan State University in 1978. Her professional background is diverse with a focus, again, on plant care. Chris worked with Dr. James Clark on soil recommendations for the current I-90 project, has taught classes at Edmonds Comminity College, ventured out on her own as a Horticultural Consultant, and spent five years at he Holden Arboretum in Mentor, Ohio as the Maintenance Horticulturalist. As one can see, Chris is uniquely qualified for her new role at the Arboretum.

A Michigander, Chris grew up in Dearborn, a suburb of Detroit. Chris's husband, George, became fond of the Pacific Northwest as a student at the University of Washington and they decided to move to Seattle in 1983. George in employed in the forest products industry. They both enjoy the outdoor life and feel quite at home in Seattle.

In addition to exciting personnel changes, things are happening in the J.A. Witt Winter Garden. Our most serious concern has been the clearing of the west section of the garden to facilitate soil renovation and grading. As you may know, this area is very poorly drained in the winter and becomes the consistency of concrete in the summer. Competitive and obtrusive native trees have been removed along with some collected trees which were also deemed inappropriate. Other plants have been moved to new homes or set aside for reuse in the Winter Garden. The ambience of this space has changed dramatically with these preparations, please come and see. So that our visitors will not be surprised by the changes and disheveled appearance of the Winter Garden during construction, we have located construction signs at critical entrance points to the area.

The Arboretum has been cooperating with the Seattle Water Department to test the viability of irrigation sensors for fine-tuning irrigation systems. We have installed sensors in Azalea Way and the Camellia collection and have been comparing the water usage of sensored areas with similar unsensored areas. We have a continuing concern about the practical and precise use of our irrigation system so that we are conserving water, administering to the needs of the plants, and curtailing the incidence of root and crown rot problems which are prevalent in Arboretum soils.

Pumpkins, *sumi painting by Reni Moriarity*.

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